

The Wei publication is generally directed to multisensory visual servoing via a neural network. The system taught by the Wei publication employs two types of sensory data, camera images and laser range data.

Importantly, the Wei publication is directed to the use of a stereo *pair of cameras*, along with at least four laser range finders. Wei publication, page 279, final partial paragraph of left column through first partial paragraph of right column, and page 276, final full paragraph of right column. Thus, the Wei publication teaches that it is necessary to image at least two points by each of at least *two distinct cameras* with a defined spatial relationship to one another (*i.e.*, stereo pair), in addition to the information derived from the four laser range finders.

In contrast, Applicants' claims are directed to methods and apparatus that employ *single camera* three-dimensional (3-D) vision for robotic guidance.

For example, claim 33 is directed to "[a] method useful in three-dimensional pose estimation for use with a single camera mounted to a movable portion of a robot." Claim 33 recites "capturing a number of images of a calibration object by the camera; determining a set of intrinsic parameters of the camera from at least one of the number of images of the calibration object captured by the camera; and determining a set of extrinsic parameters of the camera from at least one of the number of images of the calibration object captured by the camera, the set of extrinsic parameters comprising a camera space-to-training space transformation defining a transformation between a camera space reference frame and a training space reference frame."

Also for example, claim 53 is directed to an apparatus useful in robotics, and recites, *inter alia*, "a *single camera* operable to capture at a number of images of a calibration object by the camera." (Emphasis added.) Similarly, claim 58 is directed to an apparatus useful in robotics, and recites, *inter alia*, "a *single camera* operable to capture a number of images of a calibration object by the camera." (Emphasis added.)

It is the problems associated with *stereo vision* based systems and other *multi-camera* systems which are addressed by the various single camera embodiments described in Applicants' specification and claims. The removal of one or more cameras typically reduces the number of known quantities, and thus reduces the number of unknowns or dimensions that can

be solved. Consequently, the Wei publication teachings with regard to stereo camera vision are not directly applicable to Applicants' *single camera* vision based methods and apparatus.

Also the Wei publication teaches an approach to *avoid* calibration. Wei publication, page 276, first full paragraph under heading I, left column ("On the contrary, a neural network approach for doing the same job can avoid all such calibrations. . ."); page 279, first partial paragraph of right column ("If we use analytic computer vision methods to solve the same problem, a lot of calibrations have to be involved [15]. The use of a neural network method avoids these computations").

In contrast to those teachings, claim 33 recites "capturing a number of images of a calibration object by the camera; determining a set of intrinsic parameters of the camera from at least one of the number of images of the calibration object captured by the camera; and determining a set of extrinsic parameters of the camera from at least one of the number of images of the calibration object captured by the camera, the set of extrinsic parameters comprising a camera space-to-training space transformation defining a transformation between a camera space reference frame and a training space reference frame."

Likewise, in contrast to the teachings of the Wei publication, claims 53 and 58 recite, *inter alia*, "a single camera operable to capture at a number of images of a calibration object by the camera and means for calibrating the camera."

Further, the dependent claims recite many limitations which are not taught or suggested by the Wei publication. For example, a number of the dependent claims recite specific acts and structures to calibrate the single camera, none of which are addressed in the Wei publication or present Office Action. Also for example, a number of the dependent claims recite specific acts and structures to determine transformations. Such acts or structures do not appear to be disclosed or suggested by the Wei publication.


### Conclusion

Overall, the cited reference does not teach or suggest the claimed features of the embodiments recited in the independent claims, and thus such claims are allowable. Because the remaining claims depend from the allowable independent claims, and also because they include

additional limitations, such claims are likewise allowable. If the undersigned attorney has overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found.

In light of the above remarks, Applicants respectfully submit that all pending claims are allowable. Applicants, therefore, respectfully request that the Examiner reconsider this application and timely allow all pending claims. Examiner Marc is encouraged to contact Mr. Abramonte by telephone to discuss the above and any other distinctions between the claims and the applied reference, if desired. If the Examiner notes any informalities in the claims, the Examiner is encouraged to contact Mr. Abramonte by telephone to expediently correct such informalities.

Respectfully submitted,  
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